

Evaluation of Correlation between Phenomenological Approach and Fracture Mechanics Approach for Asphalt Concrete Fatigue Performance

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SRA

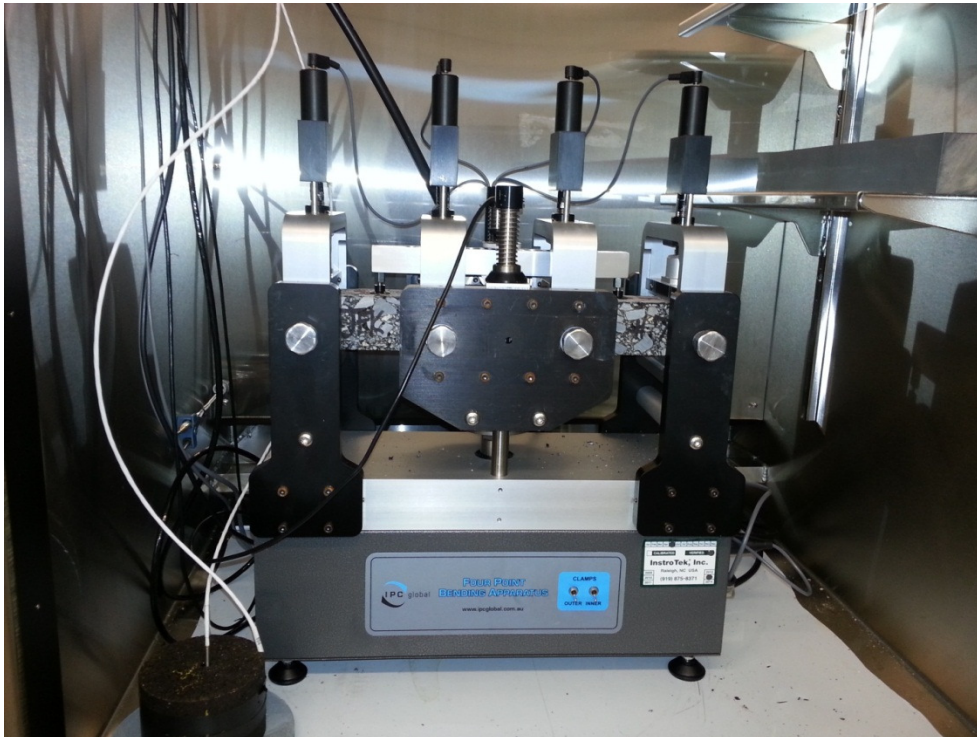
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Introduction

- Two categories of laboratory approaches for fatigue resistance evaluation:
 - Phenomenological Approach
 - Fracture mechanics Approach

Phenomenological Approach

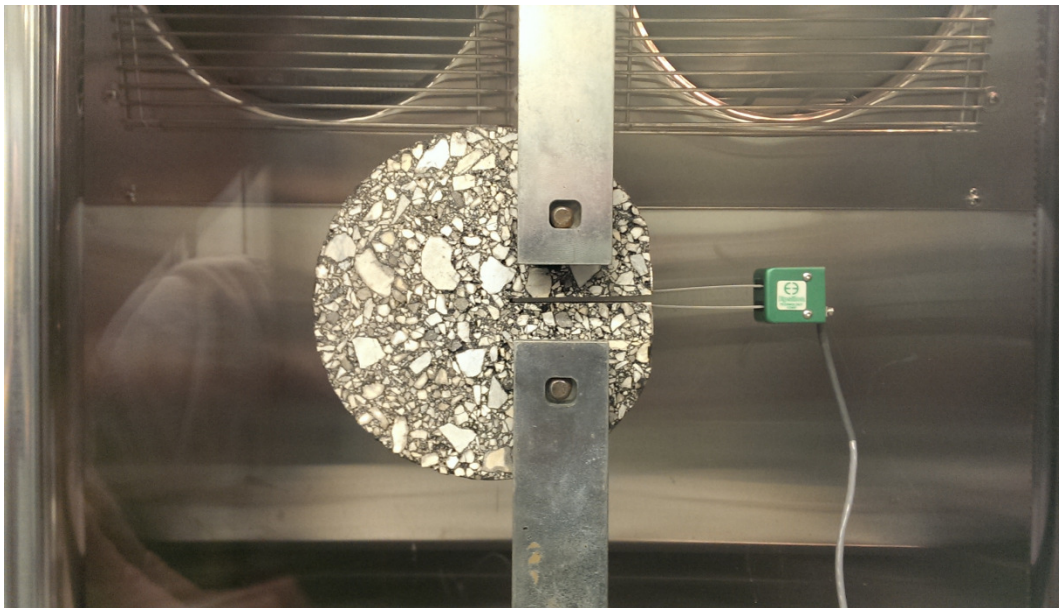
- Use repeated strain or stress to simulate the repeated traffic load.



- Time-consuming
- High variation

Fracture mechanics Approach

- Fracture mechanic approach focuses on the cracking initiation and propagation. This method relates fatigue performance to the various materials fracture parameters.

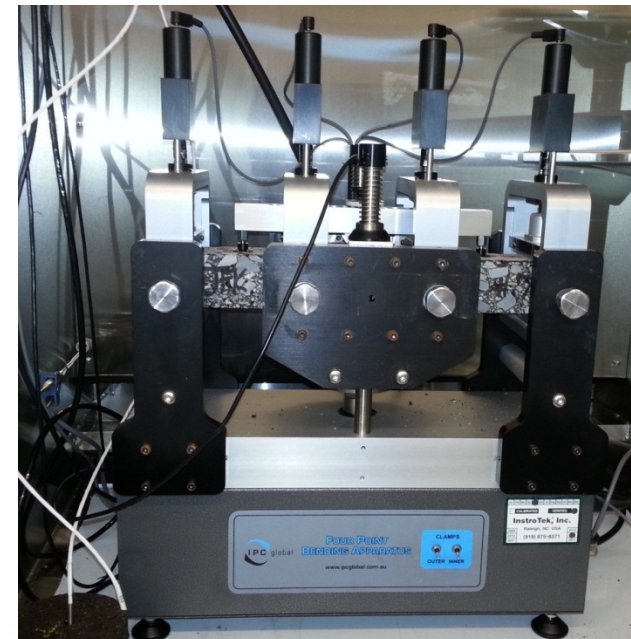
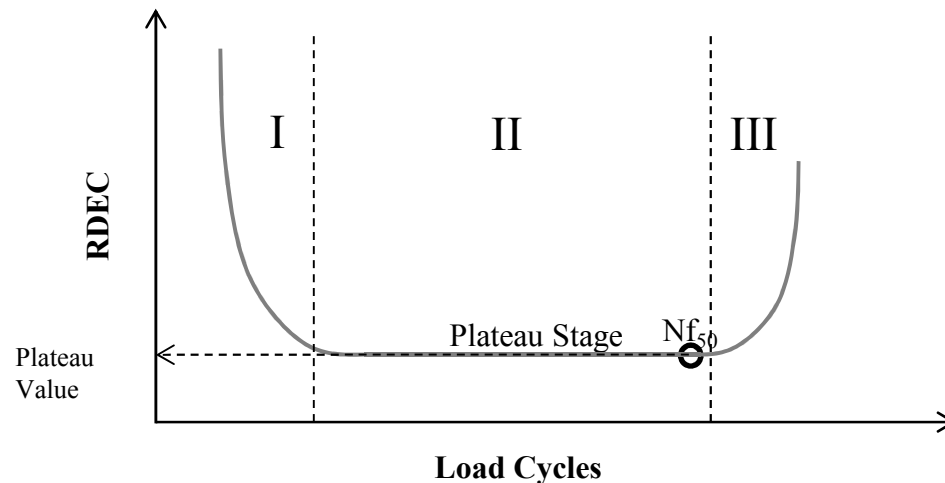


Objective

- Evaluate the relationship between phenomenological approach and fracture mechanics approach.
- Characterize the fatigue behavior using fracture parameters
 - Phenomenological Approach:
Flexural Beam Fatigue
 - Fracture Mechanics Approach:
Disk-Shaped Compact Tension (DCT)
Indirect Tensile Test (IDT)

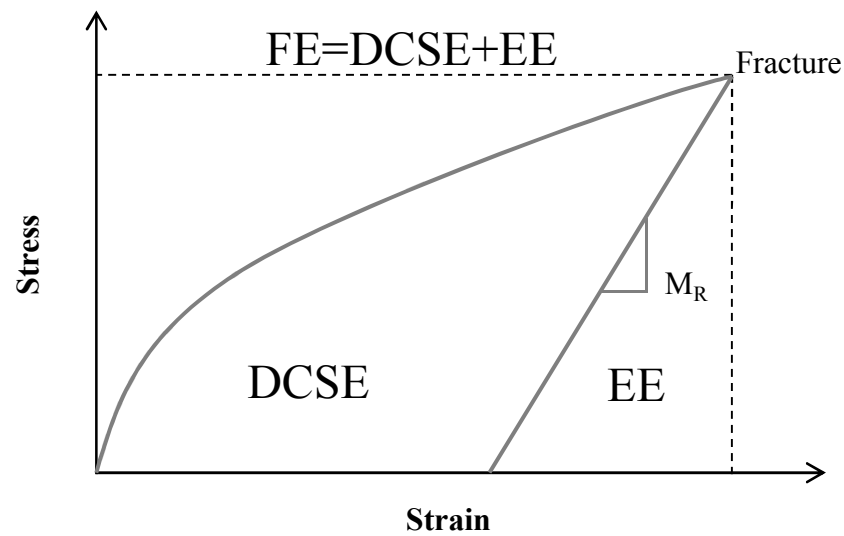
Flexural Beam Fatigue

- Two Failure Criteria
 - N_f : Number of the cycles when the stiffness reduces to 50% of the initial stiffness
 - Plateau Value: Ratio of dissipated energy change (RDEC) at N_f



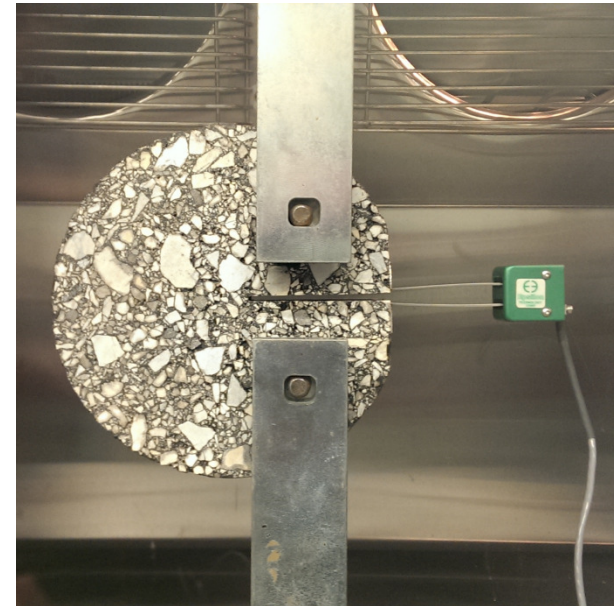
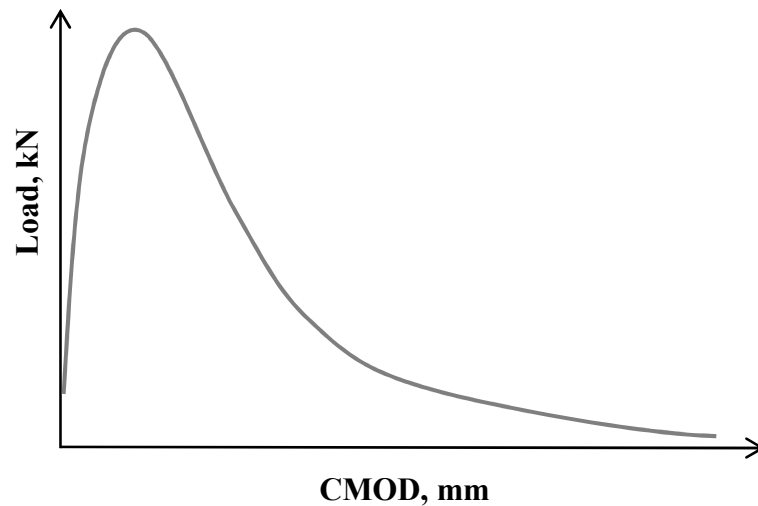
IDT

- Dissipated creep strain energy (DCSE) and Fracture Energy (FE) which are two thresholds related to cracking initiation.



DCT

- Fracture Energy = Area under Load-CMOD Curve/Area of Fracture Surface.

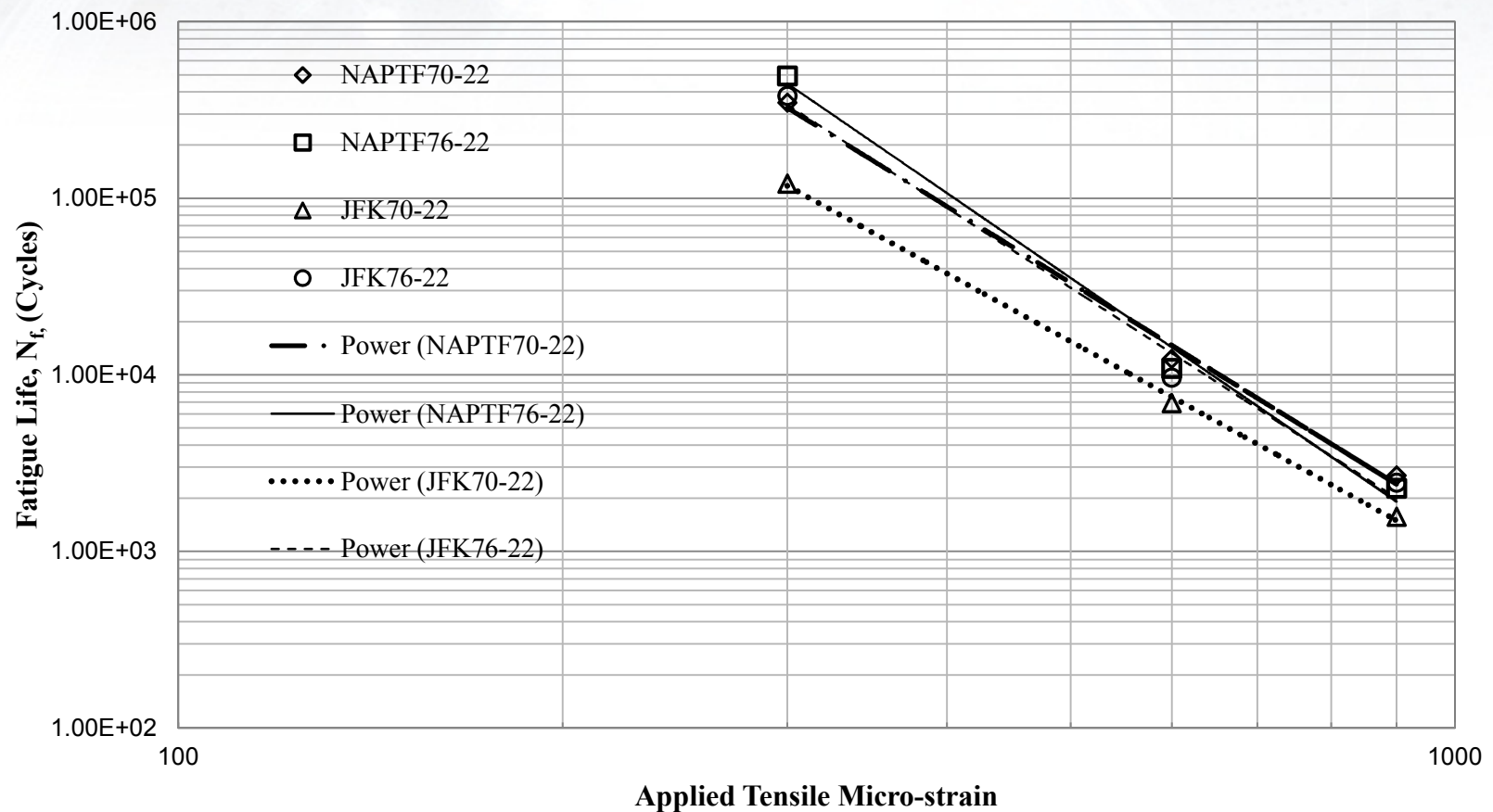


Test Program

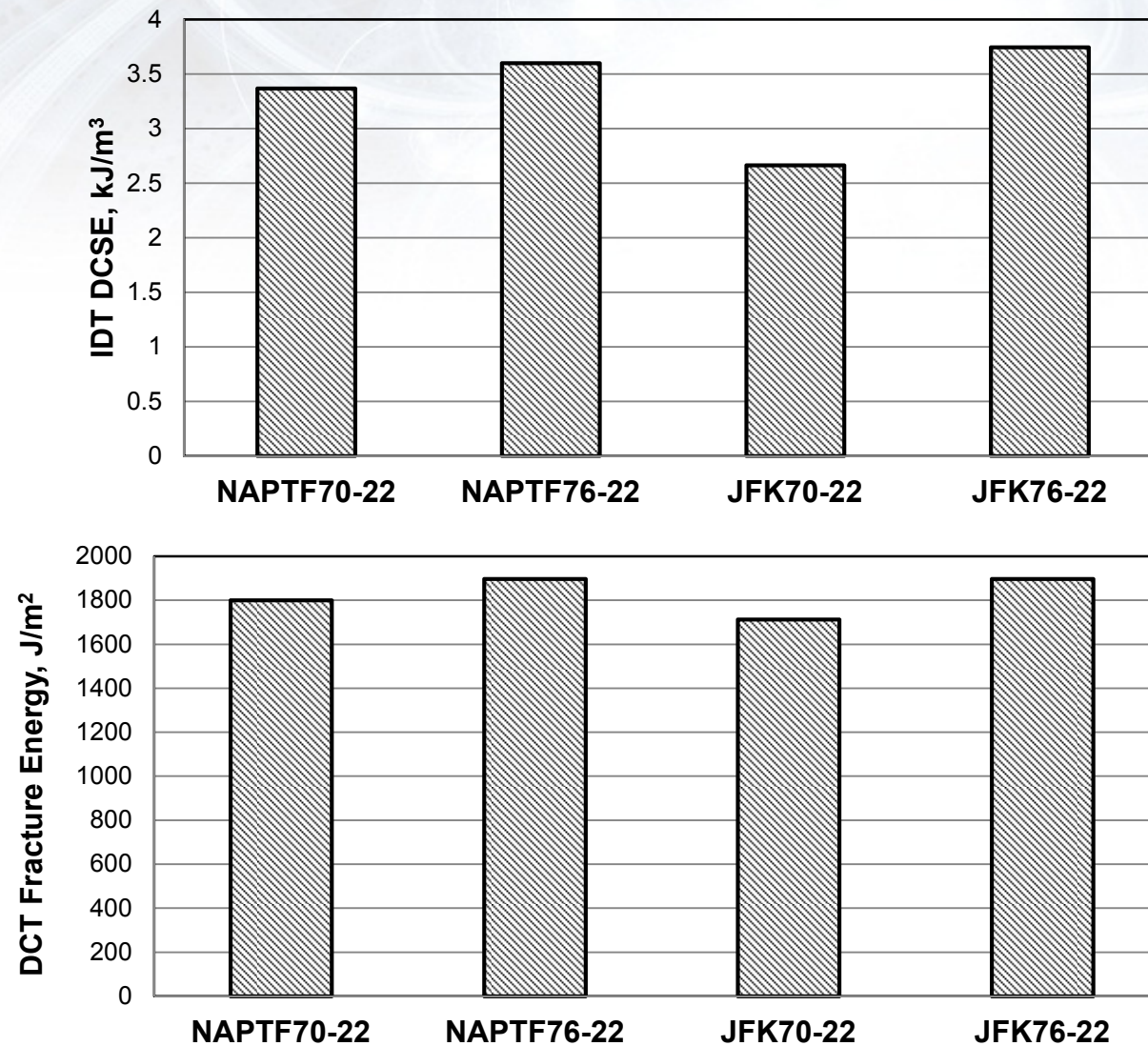
- Two aggregates
 - NAPTF
 - JFK
- Two Binders
 - PG70-22
 - PG76-22

Test	Strains	Temperature	Replicates	Total Samples
Flexural Beam Fatigue	300, 600 and 900 $\mu\epsilon$	15°C	3	36
IDT	N/A	15°C	3	12
DCT	N/A	10°C	3	12

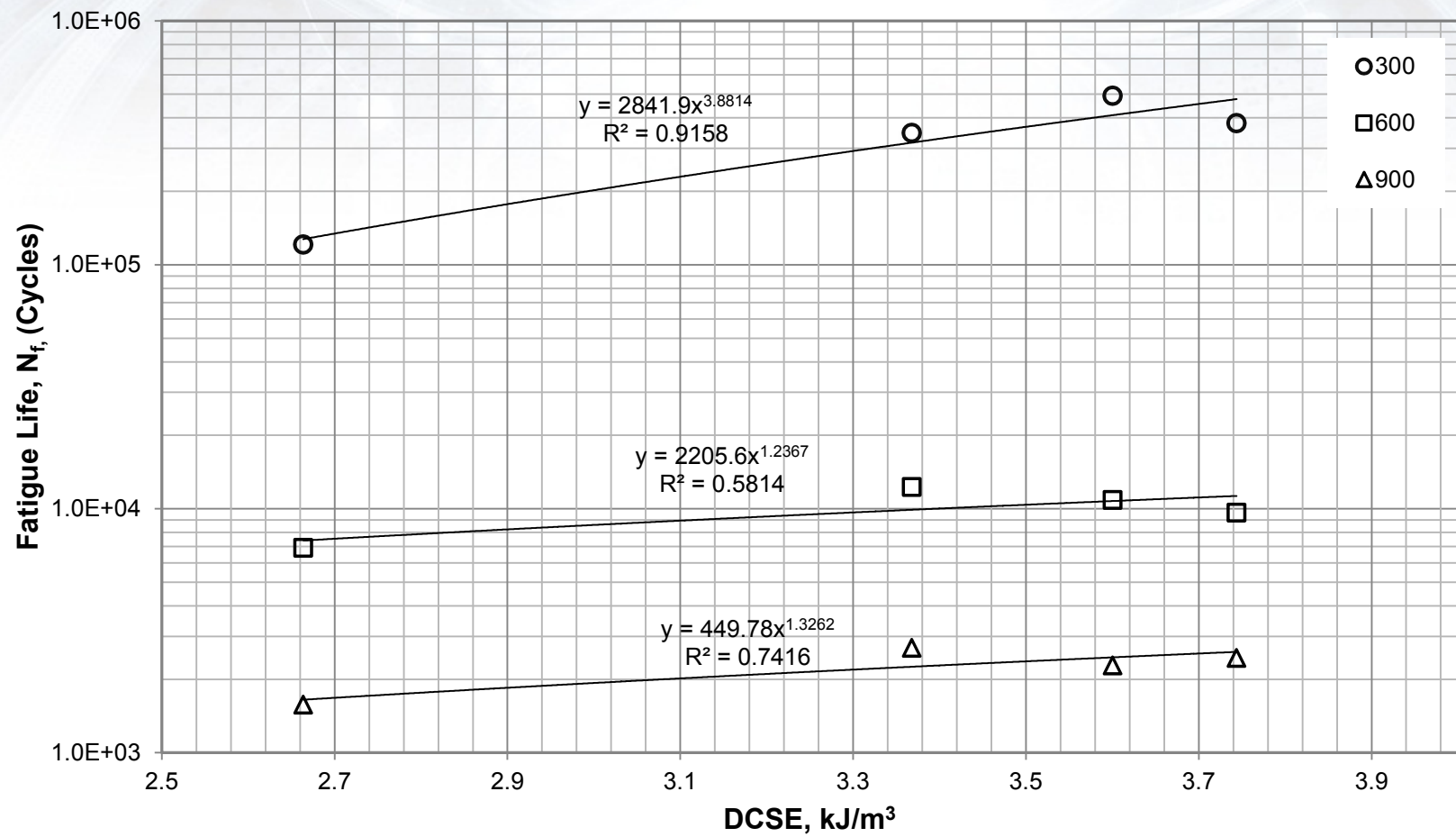
Flexural Beam Fatigue Test Results



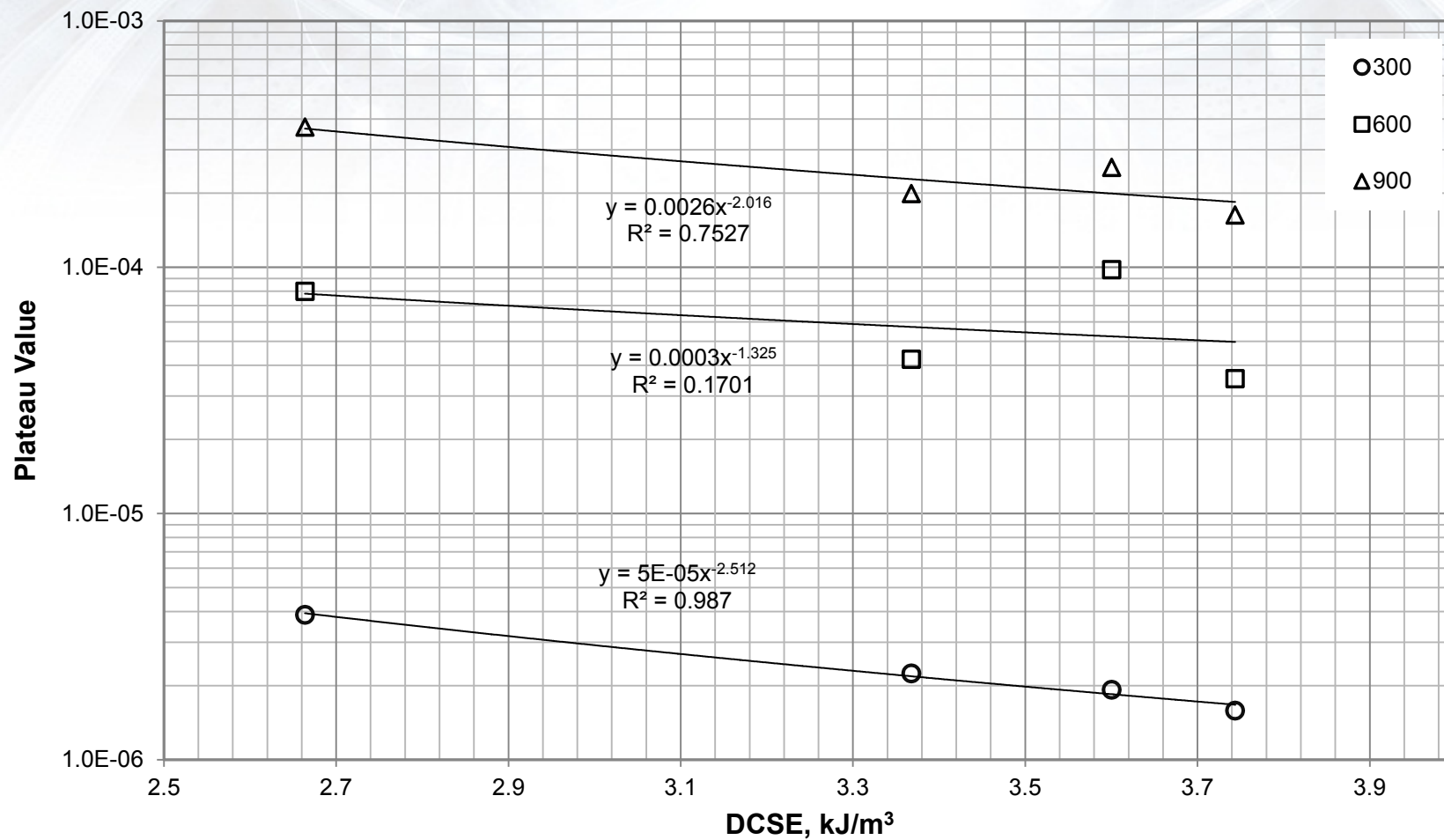
IDT and DCT Results



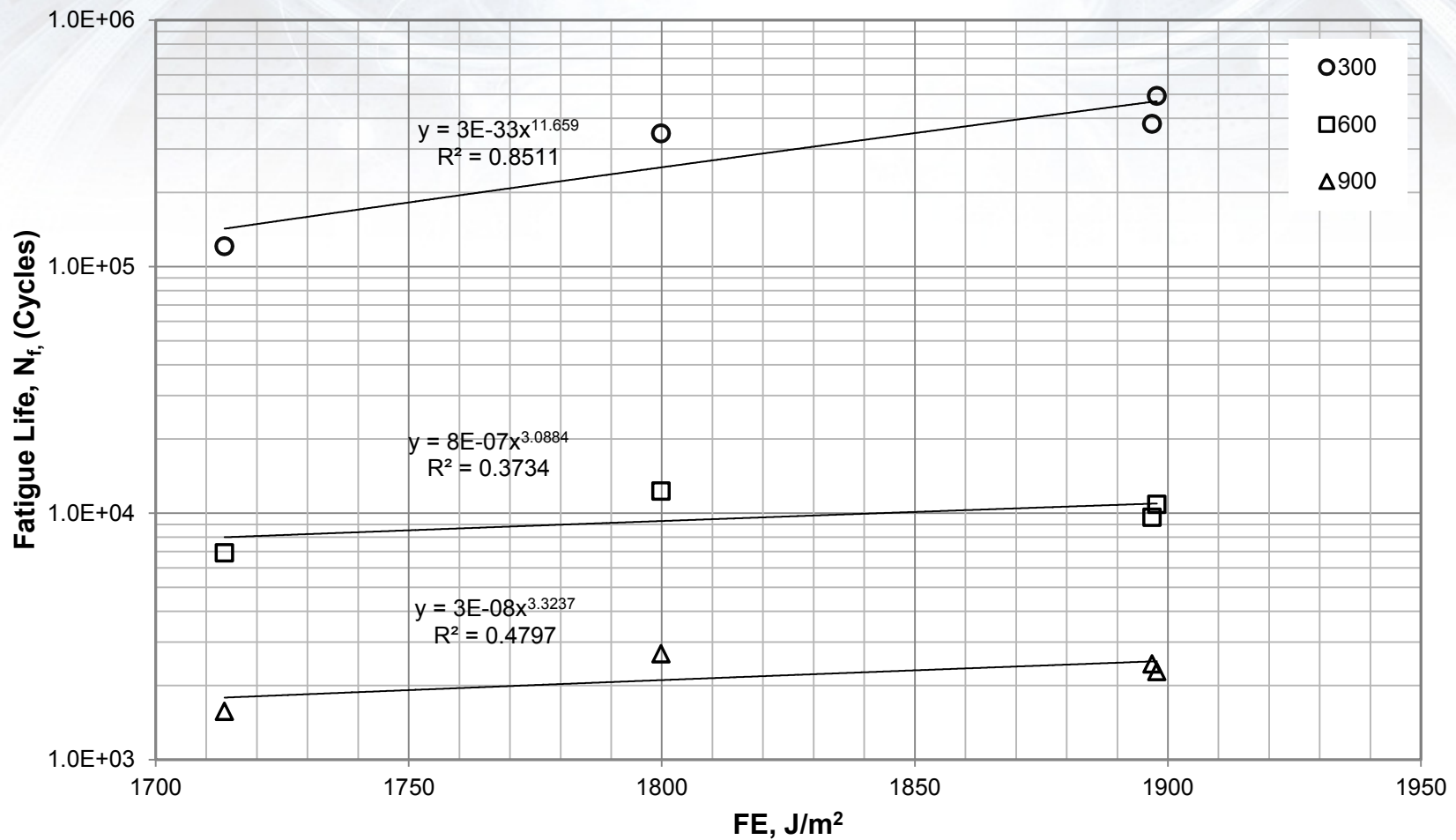
IDT vs Beam Fatigue



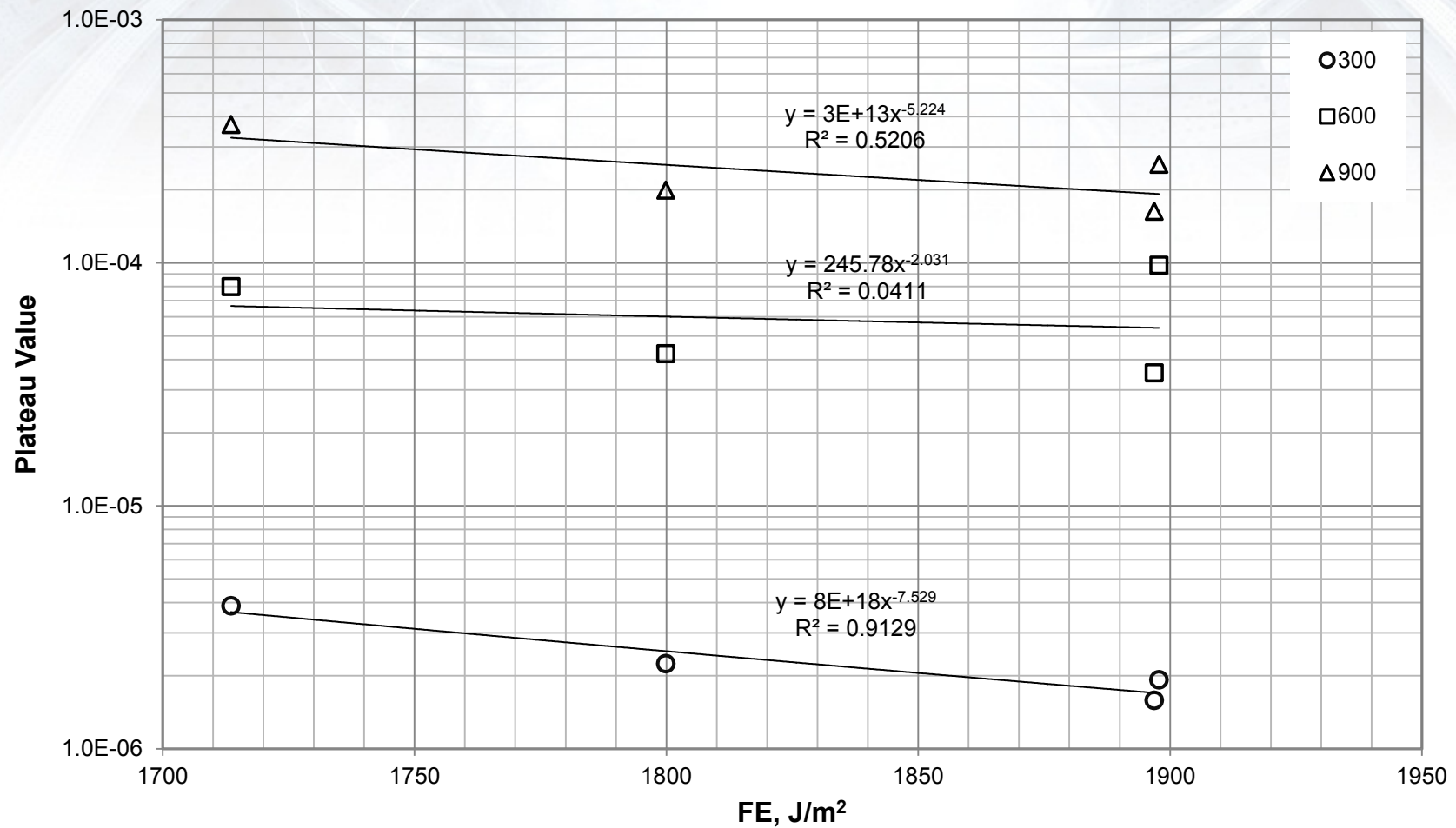
IDT vs Beam Fatigue



DCT vs Beam Fatigue



DCT vs Beam Fatigue



Summary

- Nf and PV of asphalt concrete were determined using beam fatigue test. The DCSE and FE were obtained using IDT test and DCT test separately.
- A strong correlation is observed between DCSE and Nf and also between DCSE and PV. The correlation is more significant at low strain level.
- Mixes with high DCSE has high Nf and low PV.
- There is a higher correlation at 300 micro strain between FE and Nf as well as between FE and PV.



THANKS

Outline

- Introduction
- Objective
- Laboratory Tests
- Result and Discussion
- Summary